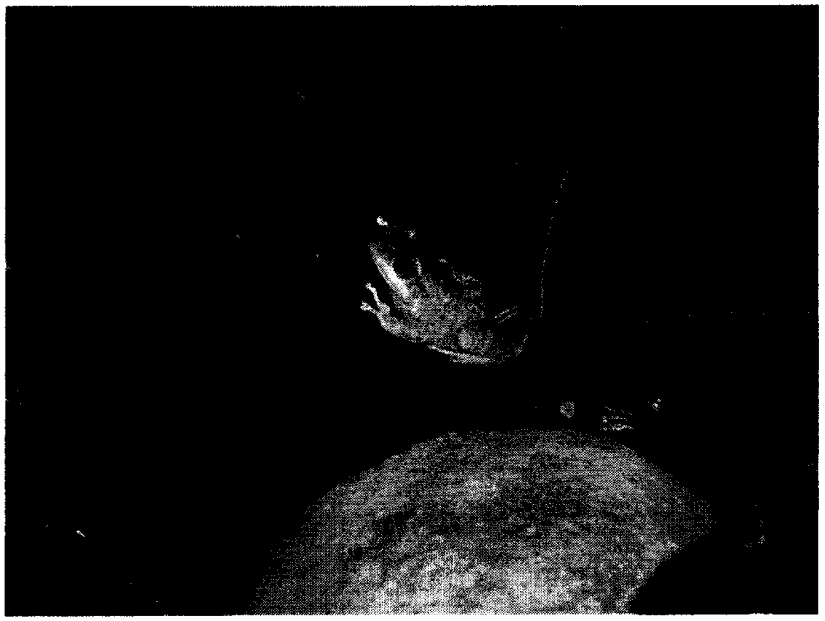
Final Environmental Assessment
Caribbean Tree Frog Control in the State of Hawaii



Lead Agency: U.S. Department of Agriculture
Animal and Plant Health Inspection Services
Wildlife Services

Cooperating Agencies: State of Hawaii
Department of Agriculture
Plant Industry Division

State of Hawaii
Department of Land and Natural Resources
Division of Forestry and Wildlife

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U.S. Department of Interior
Fish and Wildlife Service

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May 24, 2004

TABLE OF CONTENTS

LIST OF ACRONYMS AND ABBREVIATIONS

APHIS	Animal and Plant Health Inspection Service (USDA agency)
BIISC	Big Island Invasive Species Committee
CFR	Code of Federal Regulations
CTAHR	College of Tropical Agriculture and Human Resources, University of Hawaii
DLNR	Hawaii Department of Land and Natural Resources
HDOA	Hawaii Department of Agriculture
DOH	Hawaii Department of Health
EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
FWS	United States Fish and Wildlife Service (USDI agency)
HRS	Hawaii Revised Statutes
IPM	Integrated Pest Management
ISC	Invasive Species Committee
ISMP	Invasive Species Management Plan
MISC	Maui Invasive Species Committee
NEPA	National Environmental Policy Act
NWRC	National Wildlife Research Center
USDA	United States Department of Agriculture
WS	Wildlife Services (USDA-APHIS program)

CHAPTER 1: PURPOSE AND NEED FOR ACTION

1.1 Introduction

Two species of Caribbean tree frogs, the coqui (*Eleutherodactylus coqui)* and greenhouse frog (*E. planirostris)* have recently become established in Hawaii. Large breeding populations of one or both species now exist on the islands of Hawaii, Maui, Kauai and Oahu. They are considered invasive pests that have the potential to severely impact Hawaii's native ecosystems, agriculture and the quality of human life (Campbell 2001a). Frog populations have been identified in 327 sites and are rapidly increasing in number USDA, NWRC (2002). The frog's establishment has prompted Federal, State and local governments to formally declare the frog a serious threat. Among them:

- The Mayor of the County of Hawaii issued a declaration of a State of Emergency on the Island of Hawaii (April 12, 2004), based on the frog's excessive noise, potential for impacts on native species and ecosystems, and threats to the Hawaii County's economic welfare. The Governor of the state of Hawaii is expected to follow suit; and

- The Hawaii Department of Agriculture (HDOA) has officially declared the coqui an agricultural pest. Intentionally transporting the frogs is a petty misdemeanor under state law (HRS Chapter 124).

Immediate action is needed to control and prevent the spread of this invasive pest.

The Caribbean tree frogs were probably introduced into Hawaii on plants imported from Florida, Puerto Rico or other Caribbean areas over the past 10 years or more. The frogs have been spread to various parts of the state through the movement of infested potted plants and other plant material or intentionally by individuals.

The Wildlife Services (WS) program of the Animal and Plant Health Inspection Service (APHIS), U.S. Department of Agriculture (USDA) (APHIS-WS) is the Federal agency authorized to manage wildlife that threaten natural resources, agriculture and human health and safety. Program authority is found in the Animal Damage Control Act of March 2, 1931, as amended 46 Stat. 1468; 7 U.S.C.426-426b and 426c), and the Rural Development, Agriculture, and Related Agencies Appropriations Act of 1988 (P.L. 100-102) and the Fiscal Year 2001 Agriculture Appropriations bill. The HDOA, Hawaii Department of Land and Natural Resources, University of Hawaii, and the U.S. Fish and Wildlife Service are cooperating in the development of this EA.

1.2 Purpose

This purpose of this EA is to analyze the environmental effects of APHIS-WS' proposed program and alternatives to control, and eradicate where possible, populations of Caribbean tree frogs on the islands of Kauai, Oahu, Maui and

Hawaii.

Objectives The objectives of the proposed control program are to eradicate incipient populations of both species of frogs on all the Hawaiian Islands, and reduce, if eradication is not feasible, high density populations on all islands

Decision to Be Made USDA Wildlife Services is the lead agency for this proposal and will make decisions based on this environmental analysis. The cooperating agencies as well as county agencies, university research programs and the public have had input into the development of this EA. Based on the analysis contained in the EA, APHIS-WS will answer these questions:

- How can USDA Wildlife Services and the cooperating agencies best respond to the need to control or eradicate the Caribbean tree frogs?
- What are the environmental concerns and consequences associated with each of the alternative control strategies?
- Might the proposal have significant impacts and require the preparation of an Environmental Impact Statement for the implementation of a control program?

1.3 Need for Action

The HDOA has officially declared the coqui an agricultural pest and intentionally transporting the frogs is a petty misdemeanor under state law (HRS Chapter 124). The establishment of coqui on the big Island of Hawaii has prompted the Mayor of the County of Hawaii to declare a state of emergency due impacts on trade, noise, and economic and ecological threats (April 12, 2004). The Governor of the State of Hawaii is expected to follow suit. Due to the impacts and threats of the Caribbean frogs, commercial nurseries and greenhouses, private residents, hotels, and State, Federal and county agencies have called upon APHIS-WS to assist in controlling this invasive pest.

Establishment in Hawaii

The coqui and greenhouse frogs are two relatively recent invasive species introductions to Hawaii (Kraus, et.al. 1999). They are both native to the Caribbean area, although one or both have become established in the states of Florida, Louisiana and Alabama (Kraus et.al. 1999). Unconfirmed reports of one or more of these species were first reported in Hawaii as early as 1988 (Kraus et. al. 1999).

In early 1992 there were only sporadic sightings of the Caribbean tree frogs on the island of Hawaii. In early 1998, eight occurrences were reported, but 2.5 years later, over 85 occurrences were documented and another 65 were reported but unconfirmed (HDOA 2001b). The coqui is now firmly established on at least 150 specific sites on the island of Hawaii and about 40 sites on Maui (See Appendices). The greenhouse frog is reported at a number of sites on Kauai, Oahu, Maui and

Hawaii. The greenhouse frog has more cryptic habits and a weak call. Their distribution in Hawaii is thought to be more widespread than coqui, but due to their low audio-detectability they are often overlooked.

The established sites of the Caribbean tree frogs include commercial plant nurseries, residential areas, resorts and hotels, public parks and sites within vacant lots and forests. The Caribbean tree frogs are being spread to additional sites primarily through the transportation of infested plant material (Kraus et.al. 1999). There are also unconfirmed reports of deliberate dispersal of tree frogs by individuals (HDOA 2001b). They have recently been detected on Guam where the greenhouse frog is now established on 100 Acres, and two coqui individuals have been captured (D. Vice, pers. comm).

In their native range in Puerto Rico, coqui populations can reach densities greater than 8,000 individuals per acre (20,000 per hectare). Populations of this size can consume an estimated 47,500 prey per night per acre (114,000 prey per night per hectare) (Kraus et al. 1999) consisting primarily of insects. Since Hawaii's climate is similar to that of Puerto Rico, it is expected that the frogs will reach these or higher densities in Hawaii (HDOA 2001a). At one collection site on the island of Hawaii, 105 frogs were collected from a 538 ft^2 (50 $m^{2)}$ area in 50 minutes (Kraus et al. 1999). Based on this collection rate, the population estimate for this site is believed to be ten times that reported for coqui in native rainforests in Puerto Rico (Kraus et al 1999). The University of Hawaii, College of Tropical Agriculture and Human Resources (undated) also reported that the coqui frog may have a higher reproductive capacity in Hawaii as compared to Puerto Rico.

Ecosystem threats

There is great concern that Caribbean tree frogs pose a threat to the stability of Hawaii's native forest ecosystems (Kraus et al 1999). The majority of native birds are partially or wholly insectivorous. The Caribbean tree frogs could indirectly affect some populations of these birds by competing for prey if the frogs spread to native forest bird ranges. Caribbean frogs could cause the decline or extinction of species with protection under the Federal Endangered Species Act because they are voracious insectivores and can reach extremely high densities (USFWS 2002). The coqui frogs now occur in Manuka State Park and Natural Area Reserve (Lisa Hadway pers comm.) and in Volcano on the island of Hawaii where native honeycreepers occur.

The tree frogs could exert predation pressure on a wide variety of native invertebrates, many of which may already be stressed due to the establishment of other non-native predators and parasitoids (Kraus et al. 1999). Preliminary analysis of the stomach contents of 266 coqui frogs in Hawaii indicates that they consume a wide variety of invertebrates, the majority of which are insects (73%). The insects were primarily ground or plant dwelling and included ants (46.7%, Formicidae), Collembola (14.3%), flies (10.9%, Diptera), bugs (10.1%, hemiptera and homoptera) and beetles (7.8%, Coleoptera). Of note, none of the 150 flies found were mosquitoes (Culicidae) and no termites (Isoptera) were found in samples. Coqui also ate small amphipods (15.7%), arachnids (5.9%), gastropods (1.3%),

millipedes (1.2%), and earthworms (1.1%). Based on the same diet analysis, 19 percent of the frog's diet consists of endemic invertebrates, only found in the Hawaiian islands (Pitt 2004). The food web balance of Hawaiian forests may be disrupted by dense populations of coqui frogs with unknown consequences for native species. Additionally, the Caribbean frog populations could support future invasions of other invasive species such as the brown tree snake by serving as a food source (Mautz 2002).

Agricultural impacts

Vendor and public concern over purchasing plant material infested with frogs is beginning to have adverse impacts on the floriculture and nursery products industry. Grower sales of Hawaii's floriculture and nursery products totaled a record $75.4 million in 1999 was $61.2 million in 2002. Hawaii is ranked fourth in the nation in volume of sales for total cut flowers and foliage for indoor and patio use (HASS 2003). Hawaii Island, with $41.6 million in sales, ranked number one among the islands in 1999 with most of the nurseries in East Hawaii where the frog populations are highest (HASS 2001).

Shipments of plants to Oahu were returned to the island of Hawaii after they were found to be infested with coqui frogs (M. Enriques pers. comm.). While the majority of plant shipments have passed inspections for the coqui frog, at least half a dozen other plant shipments have been held on the island of Hawaii because of frog infestation.

Hawaii's horticultural exports may also be affected by the Caribbean frog as described in the following examples. Two calling coqui males were found in separate locations in Guam in areas associated with nursery plants (a plant nursery and a recently landscaped hotel). In each case, the frog was identified and captured. A greenhouse frog population on Guam has recently become established and is centralized around the same nursery where one of the single coquis was captured. Although no frogs have yet been identified in ornamental plant shipments from Hawaii, they are clearly the logical source of the two arrivals (D. Vice, pers. comm.).

In another recent example, a single container was held at Guam's Plant Inspection Station after three single calls were detected. The calls could not be confirmed as from inside the container or outside. (This inspection area has been used for some time as the point of release for ornamental shipments, so it is conceivable a frog had arrived on a previous container). The majority of the shipment was effectively destroyed by methyl bromide fumigation for a number of quarantine pests detected (other than frogs).

Noise impacts

High densities of the coqui frog in residential areas have become a noise nuisance due to the male's loud calls which have been recorded in Hawaii in excess of 70 decibels (Benevides 2004) and can reach 95 decibels for a single calling frog at 50 cm (Stewart and Bishop 1994). The Hawaii Department of Health's maximum

permissible sound level is 70 decibels. Complaints have been reported from residents and tourists who are disturbed by calling frogs (Kraus et al. 1999). Noise impacts have contributed to real estate and tourism impacts.

Real estate and tourism impacts

The coqui frogs are having a negative impact on real estate on the island of Hawaii. There is also concern that the coqui frogs will affect the tourism industry. A February 27, 2004 survey by the Hawaii Island Board of Realtors, revealed that realtors are disclosing the presence of coqui frogs on listed properties on the island of Hawaii to protect their clients and some buyers have changed their minds when they learned of the presence of coqui. Based on the survey, the estimated range of real estate transactions affected by the presence of the coqui has been $4.6 to 6.5 million, and more is expected to be reported as survey results continue to come in (Arnold Hara, pers. comm.). The Hawaii County Mayor's Office and Hawaii island office of HDOA receive about five complaints each day from residents and visitors about the coqui noise issue. A number of news articles in local and national newspapers attest to residents' view of the coqui as an unwanted pest (Edwards 2001, CBS News 2002, Command 2001, Song 2000, TenBruggencate 2001, Thompson 2000).

1.4 Biology

The coqui frog is a native of Puerto Rico where it has been extensively studied in the field and laboratory with respect to its development, morphology, metabolism, neurophysiology and reproduction (Campbell 2001a). Much less is known about the greenhouse frog.

The developmental biology of the coqui frog is not typical of common bullfrogs because the fertilized egg undergoes direct development rather than passing through a free-living, tadpole stage. Standing water is not required for egg-laying (Townsend and Stewart 1985, 1994). Coqui deposit 4-6 clutches of about 28 eggs each (range 16-41) per year, with a developmental period of 17-26 days, a time between clutches of about eight weeks, and a time between generations (i.e., from egg-laying adult) of about eight months (Townsend and Stewart 1994, Kraus et al. 1999). Males guard the eggs to keep them from drying out (Taigen et al. 1984) and in severely dry conditions they will leave the nest, gather moisture, and return to rehydrate the eggs (Michael 1995).

In its native range, coqui frogs consume a diet consisting mostly of insects, but may include other invertebrates, such as mollusks, arachnids, centipedes and millipedes (Stewart and Woolbright 1996). Hymenopterans, primarily ants, accounted for 38 percent of the total number of prey found in coqui stomachs but made up only 6 percent of the prey volume due to their relatively small size. Orthopterans, primarily crickets and roaches, accounted for 70 percent of the total prey volume (Stewart and Woolbright 1996).

Numerous invertebrates and at least 19 species of vertebrates feed on coqui frogs in its native range. Vertebrate predator species include two frogs, three lizards,

three snakes, eight birds and three mammals, with birds consuming the most frogs (Stewart and Woolbright 1996). By far the major predators on coqui eggs are the coqui themselves. Both sexes but especially males will eat coqui eggs (Townsend 1984, Townsend et al. 1984). Parental male coqui frogs may eat their own eggs if disturbed early during brooding. Egg-eating by other males is a common behavior in coqui, hence the males defend the egg clusters (Hara et al. 2002).

1.5 Location and Scope of Analysis

Caribbean tree frogs have been reported from 327 sites occupying approximately 3,000 acres on the islands of Hawaii, Maui, Oahu and Kauai which is 0.042 percent of the total land area of the state (See Appendices). The populations are growing but they are still discrete, limited to the vicinity of introduction. A few sites on the island of Hawaii have population densities that are high and cover a number of acres, however, the majority of reported sites have a very small number of frogs. Most of these sites are located on un-cleared or vacant lots in residential communities, at hotels and business establishments where landscape plants have been introduced. Most, but probably not all, populations of coqui are susceptible to eradication efforts because numbers are still low at most sites and because males can readily be targeted for removal, thereby halting reproduction (Kraus et al. 1999). Greenhouse frogs will be more difficult to control or eradicate because they are cryptic and less noticeable.

Table 1. The number of verified and reported locations of Caribbean tree frogs for each island as of June 2002 (See Appendices).

	Hawaii	Maui	Oahu	Kauai	Total
Coqui Frog	>200	40	22	6	>268
Greenhouse Frog	43	1	13	2	59

This EA evaluates Caribbean frog control efforts that could occur at any present or future reported and verified sites throughout the State of Hawaii. These currently include the islands of Hawaii, Maui, Kauai and Oahu but would include Lanai and Molokai if the Caribbean tree frogs are discovered on these two islands. Some of the known sites are on state and county lands but the majority are on private lands.

This EA analyses various alternatives and methods by which Caribbean tree frog control could be carried out to reduce or eliminate populations to protect native Hawaiian ecosystems and alleviate the problems associated with having frogs on or near residences, hotels and other businesses. The potential methods that may be used and the aspects of the human environment that could be affected are discussed in Chapters 2, 3 and 4.

1.6 Related Caribbean Tree Frog Control Efforts

The proposed action is part of an Invasive Species Management Plan (ISMP) to Eradicate *Eleutherodactylus* Frogs from the State of Hawaii developed by the U.S. Department of Agriculture and the Hawaii Department of Agriculture (USDA and

HDOA 2001). The ISMP is comprised of elements that would be implemented by a number of federal, state, county agencies, individuals and industry, either simultaneously or sequentially. No single element is a panacea, but combined and working synergistically in an integrated approach offer the best chance of controlling the pests.

Research and Field Trials

Research on controlling the tree frogs began in 1999 by USDA Wildlife Service - National Wildlife Research Center (NWRC), Hawaii Field Station, under a cooperative agreement with HDOA. Laboratory tests were conducted to evaluate 35 pesticides and pharmaceutical substances that might be used in controlling tree frogs in Hawaii (Campbell 2001a). Caffeine and resmethrin (a synthetic pyrethroid based aerosol pesticide) showed success in killing both species of tree frogs. Despite its effectiveness, the Resmethrin aerosol product was not considered a likely candidate for the control of tree frogs since it was designed for spot treatment of plants in the nursery or around the garden, and the aerosol product would be costly and impractical for wide-scale use (Campbell, 2001a).

The NWRC study also found that dermal exposure to caffeine and water caused 90 percent or greater mortality to both species of frogs. Field efficacy trials subsequently were conducted to test the application of caffeine in floriculture and nursery crops (Campbell 2001b). These trials showed that a single spray application of 2 percent caffeine solution caused a 100 percent decline in the relative abundance of tree frogs (Campbell 2001b). Concentrations down to 0.5 percent were tested with similar success depending on the density and type of foliage (HDOA 2001b).

As a result of the caffeine tests, the Hawaii Department of Agriculture and the Department of Land and Natural Resources applied for a Federal Insecticide Fungicide and Rodenticide Act (FIFRA) Section 18 Specific Emergency Exemption to treat up to 1,200 acres with caffeine to control the tree frogs in order to protect the native biota. The exemption was granted for one year by the U.S. Environmental Protection Agency (US EPA) beginning September 27, 2001.

EPA classified caffeine as a restricted use chemical, requiring that a user be a certified applicator. HDOA, Pesticides Branch, imposed additional specific restrictions on the use of caffeine. Due to some of these stringent requirements, there was no use of caffeine to control the tree frogs for most the exemption period. Only at the very end of the exemption period was a caffeine application conducted at three sites on Maui by the Maui Invasive Species Committee (MISC) under APHIS-WS-NWRC supervision. This application was designed specifically to obtain efficacy and non-target data that were required by EPA. The Maui application of caffeine was the first test of the efficacy of caffeine in a large-scale field situation and was considered successful.

Additional experimental work was conducted by the State of Hawaii Department of Agriculture and the University of Hawaii - College of Tropical Agriculture and

Human Resources, to identify other products that could be used by the public, without the many restrictions that were imposed for caffeine.

Calcium hydroxide, or lime, is a commonly used soil amendment used to raise the pH and add calcium to soils . Hydrated lime is not registered for use as a pesticide. Little research is currently available on the efficacy of hydrated lime in controlling frogs. Preliminary studies suggest that it may be effective under certain conditions but further research is needed (W. Pitt., pers. comm.).

The application of hot water at 45 degrees C (113 degrees F) to plants for 3 minutes was found to be lethal on *Eleutherodactylus* frogs on potted tree seedlings (A. Hara, pers. comm). An apparatus was developed by the University of Hawaii at Hilo, the Cooperative Extension Service and the Hawaii Division of Forestry and Wildlife at the tree nursery in Hilo in which potted plants move under a conveyor belt through the hot water treatment. Frogs were killed when subjected to this hot water treatment. The treatment could be applied to commercial nursery operations but so far it has not. Other tests showed that vapor heat treatment used to control fruit flies in papaya, was also effective in killing tree frogs (A. Hara pers. comm.), however neither treatments are in current use due mainly to logistical problems and cost.

Citric acid is a pesticide substance that is exempt from FIFRA requirements (40 CFR Part 152.25). NWRC initially tested citric acid in the laboratory after learning of its use to control Cuban tree frogs by Sean McKeon, former Honolulu Zoo curator of reptiles and amphibians. Under laboratory conditions, NWRC found that citric acid was effective at consistently killing the two species of Caribbean tree frogs at all citric acid:water concentrations at or above 16 percent (64, 32, 16 ,12, 10, 8, & 4 percent tested). The citric acid was found to be dosage dependent with differential efficacy at dosage levels less than 0.9 ml solution when directly applied to the frog (0.2 to 2.0 ml tested). Further tests were conducted by HDOA, NWRC and CTAHR to determine plant phytotoxicity, and a demonstration project at Lava Tree State Park was implemented to determine its effectiveness under field conditions and to determine whether there were any adverse effects on non-target species.

Currently, citric acid is cleared for general use to control tree frogs in Hawaii. Further research has shown, however, that Caribbean tree frogs collected during a severe drought were not as susceptible to citric acid solutions (R. Sugihara, pers. comm). The frogs apparently regulated moisture absorption and loss in some way during the drought. Successful use of citric acid on tree frog populations at Manuka State Park on the island of Hawaii and Poipu on Kauai, however, indicate that the frogs are susceptible to the citric acid in relatively dry areas. NWRC Hilo Field Station is in the process of developing research protocols to understand this phenomenon.

In February 2003, APHIS-WS began a field study to evaluate citric acid use on a greenhouse frog population in the resort area of Poipu on Kauai. Greenhouse frogs occurred throughout the resort area at some of the hotels, but were found to concentrate in the irrigation control boxes where they sought a moist refuge from the normally dry climate. This made control efforts possible. Control boxes were

checked weekly and a 16 percent solution of citric acid was used to kill the frogs that were found within. At one hotel the percentage of irrigation control boxes with frogs went from 31.1 percent to 1.2 percent after 10 weeks of control. The trial was considered successful at reducing the greenhouse frog population inhabiting the irrigation control boxes at these hotels in Poipu.

Legal Efforts

The transport of Caribbean tree frogs around the state is an illegal activity, but the law requires proof of intent to deliberately spread the frog, which is difficult to prove. In a letter to the floriculture and nursery plant industry dated June 28, 2000, the Department of Land and Natural Resources reminded the industry that spreading the frogs was illegal and asked the industry to police itself and ensure that frogs were not spread through their trade. Despite this warning, it appears that frogs are still being dispersed through the potted and cut flower trade.

A protocol for inspecting, sanitizing and modifying habitats was distributed to the nursery industry by the Hawaii Department of Agriculture. The Hawaii Board of Agriculture has since declared the coqui frog an agricultural pest, thereby restricting the movement of plant products between the islands if they are infested with the frog. There is at present, no such designation for the greenhouse frog. Shipments of plants to Oahu were returned to the island of Hawaii after they were found to be infested with coqui frogs (M. Enriques pers. comm.). While the majority of plant shipments have passed inspections for the coqui frog, at least half a dozen other plant shipments have been held on the island of Hawaii because of frog infestation.

Citric acid is now being used to sanitize export-bound nursery plants that show no signs of phytotoxicity to the solution; but citric acid can cause leaf chlorosis to some delicate plants and flowers. APHIS-WS-NWRC researchers found that rinsing plants with tap water within one hour of spraying minimizes damage.

Public Education and Assistance

Informational and planning meetings have been held with key officials from Federal, State and county agencies and with stakeholder associations in Hawaii. An initial control plan was developed by the Hawaii Department of Agriculture and presented to the [redacted].

Pest alert leaflets and brochures to educate the public and commercial growers on the identification, biology, and control of the couqi and greenhouse frog were produced by CTAHR and Wildlife Services and were widely distributed. CTAHR also produced a video that was aired on the public access channel.

Wildlife Services, CTAHR and the Hawaii Department of Agriculture are actively working with community and neighborhood associations to provide basic information and technical assistance in controlling frog infestations on the island of Hawaii. To date, meetings have been held with [redacted]

[redacted]. The Hawaii Department of Agriculture has purchased five 100 gal tanks and spray pumps for loan to community groups to control the frogs.

1.7 Summary of NEPA Public Involvement Efforts

Public participation in the National Environmental Policy Act (NEPA) process for this proposal was conducted consistent with the lead agency's NEPA procedures. The public involvement and notification process was threefold:

Issues related to the proposed action were identified during an interagency meeting on July 13, 2002, where ten cooperating agencies conducted early planning and provided input to identify preliminary issues for the environmental analyses. The public outreach included an information gathering phase wherein government agencies notified potentially interested groups or individuals (representing pro-frog organizations, animal rights groups, local citizens, land owners, land managers, technical experts, and government officials). An invitation for public involvement was distributed via email network on July 17, 2002. The invitation was also published in the August 8, 2002 issue of The Environmental Notice, a semi-monthly bulletin of the State of Hawaii Office of Environmental Quality Control. APHIS-WS received nine responses from the public outreach process; five from the island of Hawaii, two from Maui and two from Oahu.

Legal notices were published for one day on January 7, 2004 in the Maui News on Maui and West Hawaii Today on the island of Hawaii and for one day on January 8, 2004 in the Honolulu Advertiser which has state-wide circulation, the Garden Island on Kauai and the Hilo Tribune Herald on the island Hawaii to solicit comments on this pre-decisional EA during a 30-day public comment period. In addition all groups or individuals expressing interest during the earlier public involvement period were sent a copy of the pre-decisional EA for review and comment. All comments were considered and substantive comments have been addressed in this Final EA. This final EA and attached Decision document and FONSI have been sent to all parties who have expressed an interest in the proposed program. In addition, notices of the Decision and availability of the final EA have been made in the same manner as the pre-decisional EA.

1.8 Related Environmental Documents

Eleutherodactylus Frog Eradication – State of Hawaii, Invasive Species Management Plan. USDA-APHIS-WS and HDOA prepared a comprehensive multi-agency ISMP as a proposal to the Secretary of Agriculture to control and eradicate the Caribbean tree frogs from Hawaii. Elements 6 and 7 of the ISMP are the subject of analysis in this EA.

Proposed Plan for Controlling the Spread of Caribbean Tree Frogs. HDOA, June 12, 2001. The first plan to develop measures to stop the spread of the Caribbean tree frogs and to begin a control program.

ADC Programmatic Environmental Impact Statement (EIS). APHIS-WS (formerly called Animal Damage Control (ADC)) issued a Final EIS on the national APHIS-WS program (USDA 1997a, revised). Pertinent and current information available in the EIS has been incorporated by reference into this EA.

1.9 Authority and Compliance

Based on agency relationships, missions, and legislative mandates, the USDA – APHIS-WS is the lead agency and decision maker for this EA, and therefore responsible for the EA's scope, content, and outcome. As cooperating agencies, the HDOA, DLNR and FWS provided input to this EA and will provide advice and recommendations to the lead agency on when, where, and how Caribbean tree frog control and eradication could be conducted.

1.9.1 Authority of Federal and State agencies in invasive species management

Wildlife Services The Wildlife Services program of the Animal and Plant Health Inspection Service, U.S. Department of Agriculture is the Federal agency authorized to manage wildlife that threaten natural resources, agriculture and human health and safety. The primary authority for APHIS-WS is the Animal Damage Control Act of March 2, 1931, as amended 46 Stat. 1468; 7 U.S.C.426-426b and 426c), and the Rural Development, Agriculture, and Related Agencies Appropriations Act of 1988 (P.L. 100-102) and the FY 2001 Agriculture Appropriations bill. APHIS-WS follows the Council on Environmental Quality (CEQ) regulations implementing NEPA (40 CFR 1500 et seq.), USDA (7 CFR 1b), and the APHIS Implementing Guidelines (7 CFR 372) as a part of the decision-making process. In accordance with CEQ and USDA regulations, APHIS Guidelines Concerning Implementation of NEPA Procedures, as published in the Federal Register (44 CFR 50381-50384) provide guidance to APHIS regarding the NEPA process.

Hawaii Department of Agriculture The Plant Quarantine program regulates the inter-island movement of plants infested with the coqui frog under section 150A-2, Hawaii Revised Statutes (HRS), and sections 4-72-3 and 4, Hawaii Administrative Rules (HAR). Section 150A-2, HRS, defines pest as an organism that is potentially harmful to agriculture and public health or has an adverse effect on the environment as determined by the Board of Agriculture. Subsection 4-72-3(a), HAR, states that plants and propagative plant parts shall be inspected prior to transport between islands, and subsection 4-72-4(b) states that a commodity infested with a pest shall not be transported between islands unless it has been treated to exterminate the pest. The Board officially declared the coqui frog, *Eleutherodactylus coqui*, a pest on September 27, 2001.

The Plant Pest Control Branch derives its authority to control pests from

section 141-3, HRS, which lists examples of pests as "insects, mites, diseases, noxious weeds, or other pests injurious to vegetation of value." The program's authority to control or eradicate pests is further defined in chapter 4-69A, HAR. Section 4-69A-2, HAR, defines other pests as any invertebrate that is harmful to agriculture or vegetation of value. Based on this definition, the Plant Pest Control program does not have authority to control or eradicate frogs or other vertebrate animals, nor does it have the authority to enter private property to control or eradicate these animals.

Importing states and countries determine whether an organism is regulated as a pest on commodities exported out of the State. No other entities have declared the frogs as pests thus far.

Hawaii Department of Land and Natural Resources All species in the Order Anura are listed as Injurious Wildlife in HRS Title 13 Chapter 124. This designation makes it unlawful for anyone to release these organisms into the wild, transport them to areas where they are not currently established, or export, them from the state. Exceptions are granted via a Division of Forestry and Wildlife (DOFAW) permit for a one-time personal use export or export to a known research institution.

U.S. Fish and Wildlife Service The Lacey Act (18 U.S.C. 42), administered by the U.S. Fish and Wildlife Service, prohibits importation into the United States or any U.S. territory or possession and shipment between the continental United States, the District of Columbia, Hawaii, the Commonwealth of Puerto Rico, and any possession of the United States of certain categories of animal species determined to be "injurious to human beings, to the interests of agriculture, horticulture, forestry, or to wildlife or the wildlife resources of the United States." Wildlife and wildlife resources are defined broadly to include all wild animals and "all types of aquatic and land vegetation upon which such wildlife resources are dependent." *Id.* § 42(a)(1). The statute gives the FWS the authority to export or destroy any injurious species at the expense of the importer, *id.*, although permits may be issued to allow importation of otherwise injurious species for specific purposes, *id.* § 42(a)(3). Regulations listing species found to be injurious under the Lacey Act are in 50 CFR, part 16.

College of Tropical Agriculture and Human Resources, University of Hawaii The College of Tropical Agriculture and Human Resources (CTAHR) is an integral part of the University of Hawaii at Manoa's Carnegie I Research Institution designation and is the Land Grant college of the University of Hawaii and state of Hawaii. CTAHR is federally mandated to fulfill the University's threefold Land Grant mission of instruction, scientific research and outreach to address State needs. The Morrill Land Grant College Act of 1862 initiated giving public land to each state to endow a college that emphasized practical education in agriculture and engineering. The Hatch Act of 1887 provided funds to each state agricultural college to operate an experiment station that promotes the use of scientific research to

solve agricultural problems. In fulfillment of these acts, the Hawaii Agricultural Experiment Station was established in 1901. Six years later (1907), the College of Agriculture and Mechanical Arts of the Territory of Hawaii was founded, marking the beginning of the University of Hawaii. Through a cooperative agreement with the United States Department of Agriculture, Cooperative States Research, Education and Extension Service, the University of Hawaii receives funding through the Special Grants Program. The Tropical and Subtropical Agricultural Research Program (TSTAR) Special Research Grant is administered through regulations established by the following federal regulation, primarily "7 CFR Parts 3015 and 3019 Uniform Administrative Requirements for Grants and Other Agreements With Institutions of Higher Education, Hospitals, and Other Nonprofit Organizations".

1.9.2 Compliance with Federal Laws and Court Orders

Several Federal laws regulate wildlife damage management. APHIS-WS complies with these laws, and consults and cooperates with other agencies as appropriate. The following Federal laws are relevant to the actions considered in this EA and with the public review process:

National Environmental Policy Act Environmental documents pursuant to NEPA must be completed before actions can be implemented. NEPA requires that Federal actions be evaluated for environmental impacts, that these impacts be considered by the decision maker(s) prior to implementation, and that the public be informed.

This EA has been prepared in compliance with NEPA (42 USC Section 4231, et seq.,); the President's CEQ Regulations, 40 CFR Section 1500 – 1508, APHIS NEPA Implementing Regulations, and APHIS-WS NEPA policy.

Invasive Species (Executive Order 13112) The Invasive Species Executive Order directs Federal agencies to use their programs and authorities to prevent the spread or to control populations of invasive species that cause economic or environmental harm, or harm to human health.

Endangered Species Act. It is Federal policy, under the ESA, that all Federal agencies shall seek to conserve endangered and threatened species and shall utilize their authorities in furtherance of the purposes of the ESA (Sec.2(c)). Section 7 consultations with the USFWS are conducted to use the expertise of the USFWS to ensure that "any action authorized, funded, or carried out by such an agency . . . is not likely to jeopardize the continued existence of any endangered or threatened species. Each agency shall use the best scientific and commercial data available" (Sec. 7(a)(2))

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). FIFRA requires the registration, classification, and regulation of all pesticides

used in the United States. The Environmental Protection Agency (EPA) is responsible for implementing and enforcing FIFRA. All chemical methods integrated into any selected program as implemented by APHIS-WS or other cooperating agencies must be registered with and regulated by the EPA and the HDOA, and used in compliance with labeling procedures and requirements.

Animal Damage Control Act and the Rural Development, Agriculture, and Related Agencies Appropriations Act The Acts authorize and direct APHIS-WS to reduce damage caused by wildlife in cooperation with other agencies.

Protection of Children from Environmental Health and Safety Risks (EO13045) Children may suffer disproportionately from environmental health and safety risks for many reasons. The Carribean tree frog eradication plan as proposed in this EA would only involve legally available and approved damage management methods in situations or under circumstances where it is highly unlikely that children would be adversely affected. Therefore, implementation of the proposed action would not increase environmental health or safety risks to children.

Impacts on minority and low income persons or populations (Environmental Justice and Executive Order 12898) EO 12898 requires Federal agencies to make Environmental Justice part of their mission, and to identify and address disproportionately high and adverse human health and environmental effects of Federal programs, policies and activities on minority and low income persons or populations. All of APHIS-WS activities are evaluated for their impact on the human environment and compliance with EO 12898 to ensure Environmental Justice.

Lacey Act (16 U.S.C. 3371 *et seq.*) The Lacey Act has implications for regulating introductions of invasive species. This law, administered by the Secretaries of the Interior, Commerce, and Agriculture, generally makes it unlawful for any person to import, export, transport, sell, receive, acquire, or purchase (or attempt to commit any such act) in interstate or foreign commerce any fish, wildlife, or plant taken, possessed, transported, or sold in violation of any Federal, tribal, State, or foreign law. *Id.* § 3372 (a)(1), (2), (4). Thus, while the statute does not substantively grant authority to regulate the importation, transportation, exportation, or possession of any species, violation of another Federal, State, tribal, or foreign law governing these activities would become a violation of Federal law and subject to particular civil and criminal penalties. See *id.* §§ 3373, 3374. The Secretaries of the Interior and Commerce have the authority to enforce laws involving fish and wildlife, while the Secretary of Agriculture has the authority to enforce laws involving plants.

National Historic Preservation Act (NHPA) of 1966 as amended (6 U.S.C. 470 et seq.) The NHPA requires: 1) federal agencies to

evaluate the effects of any federal undertaking on cultural resources, 2) consult with the State Historic Preservation Office regarding the value and management of specific cultural, archaeological and historic resources, and 3) consult with appropriate American Indian tribes or Native Hawaiians to determine whether they have concerns for traditional cultural properties in areas of these federal undertakings.

Texas FOIA Decision The U.S. District Court in Waco, Texas issued a judgment on September 30, 2002, enjoining APHIS-WS from releasing any personal identifying information in violation of the Freedom of Information Act (FOIA) and Privacy Act. On February 14, 2003, the court issued a final judgment and permanent injunction. Pending further clarification from the court, APHIS-WS interim policy states that it will redact all private cooperator names, including associations, organizations and other such entities as defined by the permanent injunction from its NEPA documents.

1.9.3 International Agreements and Authorities

The World Trade Organization (WTO) Agreement on the Application of Sanitary and Phytosanitary (SPS) Measures, 1995 The SPS Agreement is a supplement to the World Trade Organization Agreement. It provides a uniform framework for measures to protect the health and lives of humans, plants, and animals. Sanitary and phytosanitary measures are defined as actions whose goal is to: 1) protect human, animal, or plant health from the entry or spread of pests, disease, or disease carrying organisms; or 2) prevent or limit other damage from the entry or spread of pests. The SPS Agreement has chosen the international standards, guidelines, and recommendations of three organizations - International Plant Protection Convention (IPPC), Codex, and Office International des Epizooties (OIE) -- as the preferred measures for adoption by WTO members.

South Pacific Regional Environment Program (SPREP) Convention, 1990 Article 14 states that the Parties shall take measures to protect rare or threatened ecosystems and species within the region. In 1999, SPREP produced an Invasive Species Strategy for the Pacific Islands Region. The Strategy promotes efforts of Pacific Island countries to protect their natural heritage from the impacts of invasive species through cooperative efforts and capacity building.

1.9.4 Hawaii State laws

Hawaii Revised Statutes Chapter 124 Injurious Wildlife All species in the Order Anura are listed as Injurious Wildlife in HRS Title 13 Chapter 124. This designation makes it unlawful for anyone to release these organisms into the wild, transport them to areas where they are not currently established, or export, them from the state. Exceptions are granted via a

DOFAW permit for a one-time personal use export or export to a known research institution.

Hawaii Revised Statutes Chapter 150A Plant and Non-Domestic Animal Quarantine "Hawaii Plant Quarantine Law" gives the Department of Agriculture responsibility to keep the State free of imported agricultural pests and allows the department to receive gifts to assist in preventing entry of brown treesnakes into the State.

Hawaii Revised Statutes Chapter 343 Environmental Impact Statements Hawaii's EIS law requires an environmental assessment be prepared for certain actions. The actions that are being analyzed in this EA would typically be subject to Chapter 343 EA requirement if they are done within the following land designations: 1) any land classified as conservation district by the state land use commission, 2) any shoreline management areas as defined in section 205A-41, 3) any historic site as designated in the National Register or Hawaii Register as provided for in the Historic Preservation Act of 1966, PL 89-665, or chapter 6E. However, according to DLNR, controlling frogs can be carried out on state lands without an EA, as defined in section 5, Part 5 of the DOFAW approved exemption list. This exemption applies when the management activity takes place over relatively small areas.

CHAPTER 2: DESCRIPTION OF ALTERNATIVES

2.1 Alternative 1 - Proposed Action

2.1.1 General Strategy

The proposed action is an integrated pest management approach wherein the most effective, selective and environmentally desirable method or combination of methods allowed under this alternative would be tailored to site-specific field conditions. Based on variables encountered in the field such as location, land use, vegetation type, and frog infestation levels, the APHIS-WS specialist would decide which of the allowable direct control methods, as well as technical assistance (advice or recommendations) would be most suitable. The USDA APHIS-WS Decision Model (Slate et al., 1992) is the standard undocumented professional decision making model which would be applied on a case-by-case basis to formulate site specific strategies for frog control within the guidelines established in this EA.

Wildlife Services has the legal mechanism to work on private residential and commercial property with the owner's written permission. Wildlife Services would coordinate with state and county officials, industry groups and landowners before initiating control operations. Operations must be requested by the landowner and an agreement to work on private property must be signed by both the landowner and APHIS-WS. Control would be implemented based on the likelihood of success, cooperation of the landowners within the infested site, the size of the infested area, and availability of resources, as well as other criteria, based on the APHIS-WS Decision Model (Slade et al., 1992).

Private Lands - Using methods described in more detail below, APHIS-WS and cooperating agencies would assist in treating areas surrounding agricultural, horticultural or floricultural sites such as commercial plant nurseries and cut flower operations at the request and permission of the landowners. The purpose of assisting commercial operations in the control of frogs is to reduce the chance of dispersal through commercial plant products. Wildlife Services may also control frogs at hotels, resorts, individual residences and other private properties on a cost share basis.

Public Lands - Wildlife Services may also work with federal, state and county agencies on public lands, including lands within conservation districts, shoreline management areas, and historic sites that have established Caribbean tree frogs populations. The areas occupied would be identified and control implemented using the methods described below. The action may also require vegetation removal to provide better access for treatments, and may be the responsibility of the appropriate land management agency. The cooperating agencies may also take action to control the frogs themselves. Prior to the operation, within such land designations, APHIS-

WS and cooperating agencies would consult with appropriate agencies having jurisdiction in protecting natural and cultural resources.

The proposed action would be conducted wherever the frogs occur around the State with emphasis on commercial nurseries and greenhouses on the island of Hawaii to contain the spread of the frog, but also at residences and on public lands.

2.1.2. Hand Capturing and Mechanical Control

Hand capturing of tree frogs typically target calling male coqui and is a logical method of control for a few individuals. Females do not call and are easily overlooked. Greenhouse frogs are more difficult to find because of their weak call. Hand capturing has been effective in dealing with an incipient infestation of a few individuals of coqui. Removing the males suppresses reproduction. Hand capture is not a viable tool for eradication of established populations. Mechanical control includes the use of traps or artificial hiding places. These methods have not been used on an operational level to control frog populations, but they have been used to study the frogs and may be appropriate, and may be used in some control situations.

2.1.3 Habitat Alteration

Undergrowth vegetation structure (ferns, herbs, saplings) may influence populations of coqui (Fogarty and Vilella 2001). In Puerto Rico, areas with denser undergrowth may harbor greater populations of coqui frogs (Fogarty and Vilella 2001). Removing the undergrowth and maintaining the area clear of such vegetation would reduce the number of frogs in a given area. Coqui populations are limited by the availability of suitable nest sites for their eggs. Favorite nest sites include the large curled leaves (both living and dead) of popular landscaping monocots such as palms, bananas, and heliconias. Other large-leafed plants also provide good habitat. If vegetation removal is desired to alter the habitat to reduce the frog population, APHIS-WS may be requested to remove vegetation by hand or APHIS-WS may require that vegetation be removed by the landowner.

2.1.4 Citric Acid

Citric acid, an all-natural product, is on EPA's list of minimum risk pesticides (40 CFR 152.25f). The proposed use is exempt from federal EPA oversight and no further testing is required by EPA for operational use. Currently, citric acid has been approved for general use by HDOA and is available to the public to control tree frogs.

A solution of 16 percent citric acid and water would be applied to an infestation site by direct spray application using high pressure pumps or backpack sprayers directly onto the frogs and the vegetation or ground that

holds the frogs to make contact with eggs and young. The proposed action calls for the application of one full treatment of citric acid intended to drastically reduce the population of frogs by an estimated 90 percent. Follow-up spot treatments will be made until the frogs are eradicated, or the level of desired control is achieved. The follow-up spot treatments would be done by the landowner on the island of Hawaii, and by APHIS-WS on Oahu, Kauai and Maui.

Field trials at Lawai, Kauai have shown that vegetation removal, as was done at Lava Tree State Park, is not always necessary to achieve the desired level of control on the frogs. Access trails may need to be cut by hand to allow personnel to drag hoses to spray the solution, but cutting is minimal. Repeated applications may be done until the desired level of control is achieved. The citric acid solution is effective in killing frogs in drier areas of the state, however, extreme droughts may limit its effectiveness and operations may have to be scheduled around these events.

2.2 Alternative 2 - Current Program (No Action Alternative)

Under this alternative, APHIS-WS would not change the status quo nor preclude the initiation of control actions in most areas by state or county agencies or individual landowners or individuals. No action, in this case, means limited Federal action, which is consistent with the CEQ's definition and requirement for a "no action" alternative. Under the "no action alternative", the Federal lead agency, USDA Wildlife Service, would not take any *additional* action to control or eradicate the Caribbean tree frogs. Individuals, landowners, commercial nurseries and State or County agencies would likely continue to take action whenever necessary to control or eradicate frogs.

APHIS-WS would continue to support research efforts to enhance and develop control techniques, and provide technical assistance to control frogs using various methods, including citric acid and water solution. APHIS-WS would not take part in any operational control efforts.

2.3. Alternative 3 – Non Chemical Methods

This action would include hand and mechanical capturing of Caribbean tree frogs. Hand capturing of tree frogs target calling male coqui and is a method of control for a few individuals in easily accessible sites.

This alternative would also include clearing and mulching or burning all or a substantial amount of vegetation and bulldozing and covering the substrate to effectively control or eradicate a population at an infested site. This action could be as large as 15-20 acres for such areas as Lava Tree State Park in Pahoa, Hawaii. Some moderate vegetation removal would be undertaken in residential areas, hotels, and parks to reduce frog habitat.

2.4. Alternatives Considered but Not Assessed In Detail

2.4.1. Biological Control

Biological control remedies require careful long term study to ensure that control organisms do not cause unintended consequences to nontarget species or become a problem themselves. Some methods such as Chytridiomycosis, a disease fungus of amphibians, are being investigated by HDOA and CTAHR. No biological control methods are available at this time.

Biological control, if implemented would be designed for control only and is not appropriate in this phase of the control and eradication plan. If efforts to eliminate source populations and incipient populations fail, biological control would then be a likely course of action. It is highly unlikely that APHIS-WS would be involved in any biological control implementation. This option is not feasible at this time.

2.4.2. Caffeine Solution

Earlier control plans considered by APHIS-WS, proposed the use of a 2 percent caffeine and water solution as the primary chemical control component in the ISMP under a proposed FIFRA Section 18 label to control Caribbean tree frogs in floriculture and nursery crops, residential areas, parks, hotels and resorts and forest habitats. The July 17, 2002, public involvement letter listed caffeine as a proposed action. The EPA has not made a decision on whether or not to approve the Section 18 application. The delay and the subsequent discovery of citric acid as an alternative, has made the use of caffeine in a APHIS-WS operational control program unnecessary. The caffeine solution would have been applied to plant foliage with appropriate ground spray application equipment. This option is no longer being considered for operational use by APHIS-WS.

2.4.3 Hydrated Lime

Calcium hydroxide, or lime, is a commonly used soil amendment used to raise the pH and add calcium to soils. Hydrated lime was suggested as a potential method for controlling frogs during interagency scoping. APHIS-WS is not considering hydrated lime as an alternative under this proposal because it is not registered for use as a pesticide and thus is not available for use to control frogs. Little research is currently available on the efficacy of hydrated lime in controlling frogs. Preliminary studies suggest that it may be effective under certain conditions but further research is needed (W. Pitt., pers. comm.). To evaluate hydrated lime as a pesticide, the potential non-target hazards associated with its use would have to be documented.

CHAPTER 3 - ISSUES IMPORTANT TO THE ANALYSIS OF IMPACTS

3.1 Issues Driving the Analysis

Issues are used to drive the analysis in Chapter 4, Environmental Consequences. Each major issue will be evaluated under each alternative and the direct, indirect and cumulative impacts will be estimated where applicable. The cooperating agencies determined through interagency consultation and through initial public involvement that the following issues should be considered in the decision making process for this EA to help compare the impacts of the various alternatives management strategies.

- How effective might the various alternatives be in controlling Caribbean tree frogs? How do they compare in meeting the objectives of the proposal? Will invasive tree frogs return after controlled? Can the program reach all areas where infestations occur? Relative program efficacy is used in addition to the environmental issues to help the public and decision maker compare the merits of the alternatives and determined which alternative would be most likely to meet the objectives of the proposal.

- What potential non-target impacts could occur from implementing frog control? Could the proposal affect threatened and endangered species or other sensitive species? Could it affect other non-target animals? Could it affect people's pets?

- What effects would control actions have on vegetation in the different targeted locations: greenhouse and nursery stock, plant materials used in landscaping, and introduced and indigenous plant communities found in parks and natural areas?

- The issues analysis will include direct, indirect, and cumulative impacts where applicable.

- What are the economic impacts of the various alternatives?

- What social values may be affected? How does the public view the presence of frogs in Hawaii. How do members of the public feel about frog control actions? Are frog control actions perceived as cruel or inhumane?

- Other ecological and environmental issues from removing frogs: indirect impacts on insects, as prey and disease vectors, and indirect impacts on frog predators, soil, water, aquatic environments, air quality, and cultural resources.

3.2 Issues Not Analyzed in Detail with Rationale

The actions discussed in this EA involve no construction. The following resource values are either not affected, or are not expected to be significantly affected by any of the alternatives analyzed: geology, minerals, flood plains, prime and unique

farmlands. There are no significant irreversible or irretrievable commitments of resources. These resources will not be analyzed further.

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

Chapter 4 provides information needed for making informed decisions on the Caribbean frog control and eradication operational objectives identified in Chapter 1 and alternatives described in Chapter 2. This chapter uses the issues identified in Chapter 3 as the evaluation criteria. Each of the issues will be analyzed for its environmental consequences under each alternative.

Each major issue will be evaluated under each alternative and the direct, indirect and cumulative impacts will be estimated where applicable. NEPA describes the elements that determine whether or not an impact is "significant." Significance is dependent upon the context and intensity of the impact. The following factors were considered to evaluate the significance of the impacts on the human environment that relate to context and intensity (adapted from USDA 1997, revised for this proposal).

- magnitude of the impact (size, number, or relative amount of impact) (intensity)
- duration and frequency of the impact (temporary, seasonal impact, year round or ongoing) (intensity);
- likelihood of the impact (intensity);
- geographic extent; how widespread the program impact might be (intensity); and
- the legal status of a species that may be affected by the action (context)

4.1 Alternative 1 - Proposed Action

4.1.1. Effectiveness

In the laboratory, citric acid was effective at consistently killing all Caribbean frogs at all citric acid concentrations at or above 16 percent. The citric acid solution was applied directly to the dorsal surface of the frogs. At concentrations slightly below this level (12 and 10 percent concentrations) more than 50 percent of the frogs died (Pitt and Sin 2003).

A pilot project to assess the efficacy of reducing both coqui and greenhouse frogs by clearing non-native vegetation and spraying a solution of 16 percent citric acid and water was conducted at Lava Tree State Park in Pahoa, Hawaii. An area of about two acres was cleared of understory in the day and sprayed using ground spray equipment at dusk. Researchers from the University of Hawaii, College of Tropical Agriculture and Human Resources evaluated the efficacy of the effort.

A day search 24 hours after treatment yielded a total of 35 frogs, with 30 (86 percent) of those found dead. A night search 32 hours after treatment discovered 93 live frogs in an untreated area but only 7 live frogs in the treated area. Two weeks after treatment, densities of coqui frogs in the treated plot returned to pretreatment levels (Chun et al 2003a). The two acres treated were only a fraction of the approximately 15-20 acres that were infested by coqui and greenhouse frogs.

Field trials were conducted on Kauai using portable backpack sprayers to apply citric acid to spot treat irrigation control boxes to control greenhouse frogs. Observers found that after the application of 16 percent citric acid solution, all frogs died within 2 hours. When checked in subsequent days, live frogs were again found in the boxes suggesting reinvasion of the boxes by untreated frogs (R. Sugihara pers comm). This reinvasion suggested that multiple treatments were necessary. Weekly treatments of these boxes commenced in February 2003. A reduction in the percentage of irrigation boxes containing greenhouse frogs was recorded over the period of February 2003 to July 2003. The average percent reduction for the 5 resort sites was 66 percent, indicating that repeated treatments were successful in reducing greenhouse frog numbers in these refugia (NWRC preliminary data).

Citric acid is effective in reducing the hatching success of coqui frog eggs. Coqui frog eggs were treated with 16 percent citric acid solution and reduced hatching rate to 3.5 percent, under laboratory conditions. Untreated coqui frog eggs had a hatching rate of 94 percent. Even after rinsing with water after one hour the citric acid reduced the hatching rate to 23.9 percent (Chun et al. 2003a).

NWRC evaluated a control operation using citric acid solution at Lawai, Kauai without vegetation clearing, except to cut access trails, in a location where the frog population was discrete and isolated, and where the entire population was exposed to control efforts. It was estimated that 125 calling males were in the area. On June 9, 2003, NWRC, HDOA and APHIS-WS applied 1,000 gals of 16 percent citric acid solution to the five-acre infestation site. The vegetation included eucalyptus trees (*Eucalyptus* sp.), Java plum (*Syzygium cumini*), hau (*Hibiscus tiliaceus*) and waiwi (*Psidium cattelianum*), with some Guinea grass (*Panicum maximum*) in openings. On June 25, 2003, two weeks after the initial application, only 8 calling males were detected. Spot spraying continued almost weekly through the summer, but most of the remaining frogs were up in trees and may have escaped the control effort. In August 2003, APHIS-WS still found 3 calling males (APHIS-WS narrative report 2003). The project was considered highly successful. Plans were made to spray the last remaining frogs after they descended or by using spray equipment that could reach high into the trees. These field trials indicate that citric acid can be an effective control tool.

4.1.2. Impact on Non-target Species

Studies conducted by the NWRC have found that non-target invertebrates are not likely to be adversely affected by citric acid. In 2003, NWRC, in collaboration with WS Operational program, the HDOA, and the Kauai Invasive Species Committee studied the effects of spray operations at Lawai, Kauai. Pitt and Sin (2004) found that there was no significant difference between the pre-treatment and post-treatment diversity and number of non-target invertebrates. Non-target invertebrates were sampled with sweep nets, pitfall traps, detritus collection, and sticky traps before and after

treatment with citric acid. Citric acid did not affect the abundance and species diversity of non-target invertebrates.

Chun et al. (2003a) found no changes in diversity or abundance of non-target invertebrates using sweep nets and pitfall traps at Lava Tree State Park in Pahoa.

Citric acid occurs naturally in soil, water, plants, animal tissues and fluids, and as a key component of cellular respiration (Hickman et al. 1986). Citric acid has no significant adverse effects on humans or the environment associated with proper use of citric acid as a pesticide (EPA 1992). It is a mild organic acid and may cause skin and eye irritation. It is commonly used in disinfectants, sanitizers, fungicides, and as a food additive. Citric Acid is Generally Recognized as Safe as a multiple purpose food substance (21 CFR 182.1033).

Most sites occupied by Caribbean tree frogs are located on vacant residential lots, residences, hotels and around floriculture and horticulture establishments where threatened and endangered species do not normally occur. The current distribution of the Caribbean tree frogs is within the known distribution of the federally listed endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*) and the Hawaiian hawk (*Buteo solitarius*) on the Island of Hawaii. In discussions with the USFWS, APHIS-WS has determined that the proposed project would not affect the Hawaiian hawk.

Hawaiian hoary bat

APHIS-WS has completed an informal consultation pursuant to Section 7 of the Endangered Species Act. The USFWS has concurred with APHIS-WS' determination that the proposed action would not be likely to adversely affect the Hawaiian hoary bat (USFWS 2004). The current and projected areas of frog infestation on the islands of Hawaii, Maui and Kauai are within the range of the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus.* Spray operations will be of short duration and only a very small proportion of the bat's habitat is proposed for treatment. Since the bat is a solitary rooster (it does not roost in colonies), and its distribution within suitable habitat is diffuse, it is unlikely that any bats would be sprayed. No habitat of the Hawaiian hoary bat would be likely to be destroyed since APHIS-WS would do or recommend only selective cutting of understory vegetation to facilitate citric acid treatments. Mechanical and hand capture of frogs would not affect bats.

Removing Caribbean tree frogs would be likely to benefit native ecosystems where they may become established by removing a voracious insectivore which can reach extremely high densities. The USFWS is concerned that the frog's establishment in native ecosystems could cause the decline or extinction of species protected under the Federal Endangered Species Act (USFWS 2002, USFWS 2004).

4.1.3. Impacts on Vegetation

The proposed action calls for an integrated approach where the understory vegetation may be thinned by hand or with hand power tools, to reduce frog habitat and to allow better access to spray citric acid. This would reduce the amount of citric acid needed to cover an area. Most of the vegetation in the current distribution of tree frogs is introduced, not native to Hawaii. All introduced species of plants can be removed and it is very likely that all would recover.

Citric acid can have minor effects on plants by causing marginal chlorosis, leaf drop, and some burning of leaves, flowers, and new growing tips of sensitive species. Phytotoxicity trials were conducted on 15 different species of nursery potted plants, including common species of ferns, anthuriums, dracenas and orchids, using 16 percent citric acid solution (Pitt and Sin 2003). The percentage of leaves damaged (16.1%) and leaf surface area damaged (2.4%) was minimal for most plants. The fern group (Davallia, Adiantum, Asplenium, Asparagus, and Nephorolepsis), Araceae (Dieffenbachia, Anthurium, Spathiphyllum and Agaonema), and Phalaenopsis orchids had some degree of minor leaf burns. Citric acid spraying caused frogs to leave potted plants and the remaining citric acid residues on plants reduced reinfestation. All plants were graded as saleable by the nursery, indicating that citric acid spray did not have a significant effect on plant appearance.

Chun et al. (2003a) found that 16 percent citric acid caused minor phytotoxic effects among certain plant species within three days following treatment when the citric acid but the area was also subjected to significant vegetation removal and disturbance. Affected plants included Koster's curse (*Clidemia hirta*), sword fern (*Nephrolepis cordifolia*), hau, calathea (*Calathea crotolifera*), and laua'e fern (*Phumatosorus grossus*).

Field evaluation of operational coqui frog control was conducted by the NWRC. The NWRC evaluated the effects of spray operations at Lawai, Kauai on plants and found little phytoxic effects on wild plants. (Pitt and Sin 2004). Common native plants (Hau, *Hibiscus tiliaceus*, and olapa, *Cheirodendron trigynum*) and nonnative species (laua'e, *Phymatosorus scolopendria*, and parrot's bill, *Heliconia sticta*) were closely monitored and no phytotoxic effects were found one week after citric acid application. No noticeable phytotoxic effects were observed on any other species present.

Rainfall or washing off the residue within 24 hours of treatment would reduce any phytotoxic effects. Rare or valuable plants could also be tested for susceptibility.

In terms of amount of impacts on vegetation, most impacts on plants would be to commercial greenhouse and nursery stock where effects can be mitigated somewhat by rinsing with water 24 hours after application. Most work that would be accomplished within the first year in non-commercial

settings would likely occur on approximately 500 acres of residential lots with mostly landscaped and introduced plants. On the Island of Hawaii, 2,727 acres are currently estimated to be infested with frogs (R. Sugihara, pers. comm.). Acreages on other islands are minor in comparison, and are estimated based on calls received on a hotline established for frog complaints. Within identified infested areas, APHIS-WS would selectively spray and either remove vegetation or recommend to the landowner that vegetation be selectively removed to facilitate treatment. Vegetation impacts would be temporary since most vegetation would recover or return to pretreatment levels within a year due to the favorable growing climate and lush growth habits of most existing plants.

Most sites known be occupied by the frogs occur on vacant residential lots, residences, hotels and around floriculture and horticulture establishments. There would be no impact on native or protected vegetation in these sites.

Effects on protected plant species

Most of the vegetation in the current distribution of tree frogs is introduced, not native to Hawaii. Results from phytotoxicity trials conducted on 15 different species of potted nursery plants indicated that some species of plants, particularly ferns, were susceptible to leaf burning. Through its Section 7 consultation with APHIS, the USFWS has concluded that because very few natural areas where listed plant and invertebrate species may be present have frog infestations, it is unlikely this treatment method would adversely affect listed plants or invertebrates (USFWS 2004). Further, APHIS-WS has agreed to notify the USFWS prior to any proposed applications in areas within the State Conservation District or those potentially containing threatened and endangered plants, so that the USFWS may review them on a case-by-case basis and propose site-specific mitigation measures. With this, the USFWS has agreed that the proposed project would not be likely to adversely affect threatened or endangered plant species.

4.1.4 Impact on Human Health and Safety

According to EPA the current registered pesticidal uses of citric acid result in only negligible human and environmental exposure. EPA has received no reports of adverse effects resulting from citric acid's use (EPA 1992). Citric acid is a severe eye irritant and a moderate skin irritant. EPA believes that no significant adverse effects to humans or the environment are associated with the proper use of citric acid as a pesticide (EPA 1992). The HDOA issued a label for using citric acid anhydrous for control of Caribbean Tree Frogs. The safety precautions section states that "Citric acid is a highly irritating and corrosive chemical. Follow safety instructions on the product label to avoid eye, skin and respiratory irritation." Using proper protective clothing and a disposable face mask is sufficient in protecting the user from the irritant. There would be no impacts to non-users if the product is used

properly. APHIS-WS will take necessary precautions to keep the public from access to control sites during operations.

The proposed action is intended to benefit human health by removing a pest which can create noise that is unacceptable to the Department of Health and to many people. For those residents and visitors that are experiencing nuisance noise problems from the frog, removal would benefit their state of well being.

4.1.5 Impact on Ecology and Environment

The USFWS feels that control of the spread of introduced frogs of the genus *Eleutherodactylus* is extremely important for the conservation of threatened and endangered species in Hawaii and the Pacific and that the careful implementation of this alternative is critical in efforts towards preventing the establishment of frogs in native ecosystems (USFWS 2004).

While citric acid's use to control Caribbean tree frogs is new and has not been subject to registration requirements other than the provision of a local use label, EPA has stated that the current registered pesticidal uses of citric acid have resulted in only negligible human and environmental exposure. EPA has received no reports of adverse effects resulting from citric acid's use (EPA 1992).

Using citric acid, as proposed under this alternative, is expected to have no effect on water quality in terms of pH. Wildlife Services NWRC program tested the pH of an agricultural reservoir for 11 consecutive days before and after treatment, at three separate sampling locations along the shore adjacent to a treatment area that was 2.5 acres in size The pH pre- and post-treatment measurements did not change. Wildlife Services will continue to monitor the pH of waterways for citric acid applications in project areas near or adjacent to waterways, until a sufficiently large sample size is obtained to make this determination conclusive. Citric acid is a well known component of carbohydrate metabolism in living organisms, and is found naturally in soil and water. It degrades readily when in contact with a variety of microorganisms that are found in soil, natural waters and sewage treatment systems (EPA 1992). Due to its tendency to degrade when exposed to normal environmental conditions, APHIS-WS expects that citric acid use as proposed, will have no effect on water pH. In addition, the EPA believes that no significant adverse effects to humans or the environment are associated with the proper use of citric acid as a pesticide (EPA 1992).

There has been a suggestion by one member of the public that Caribbean tree frogs consume mosquitoes and thereby reduce the threat of dengue fever. The outbreak of dengue fever in Hawaii is recent, more recent than the invasion of Caribbean tree frogs and there has been no evidence that the frogs have consumed the mosquito vectors. The Department of Heath noted in a letter dated December 13, 2001, that *"coqui frogs are not a health benefit to Hawaii since they only come out at night, while the dengue fever*

carriers, a particular species of mosquito named Aedes albopictus, only come out in the day." Furthermore, studies of the stomach contents of frogs have found that they are not consuming mosquitoes (Pitt 2004).

This alternative would have only minimal effects on soils or water quality (sedimentation) because there would be no ground disturbance or construction. Vegetation would be selectively cut by hand or with power equipment, but roots would be left intact and topsoil would not be removed.

Citric acid spray would have temporary and minor impacts on air quality in the immediate area. Only applicators would potentially be at risk and they would be required to use protective equipment and keep people from entering treatment areas. Adverse effects on applicators are unlikely.

No known historic resources occur in sites currently occupied by frogs. Most sites occupied by Caribbean tree frogs are located on vacant residential lots, residences, hotels and around floriculture and horticulture establishments. APHIS-WS would consult with the State Historic Preservation Office if frogs are found in previously undisturbed areas or areas known to contain historic resources to determine if the proposal could affect historic resources and to adopt appropriate protective measures if necessary in compliance with Section 106 of the National Historic Preservation Act.

4.1.6 Social - Economic Impacts

The proposed action is intended to alleviate economic impacts on commercial nurseries, tourism and potentially declining property values.

In its entirety, the eradication of Caribbean tree frogs from the state of Hawaii would put about $3.5 million new dollars into the state economy each year and create approximately 30 to 40 new jobs. This level of funding is not currently available.

Some individuals advocate for the presence of the coqui in Hawaii (Armstrong 2001, Command 2001). There are two organizations that are opposed to controlling coqui frogs in Hawaii: an animal rights organization based on Oahu; and an organization dedicated to reeducating the public on the merits of the coqui tree frogs in Hawaii. Some individuals from Puerto Rico have also expressed a concern over killing frogs since the coqui is a national symbol for that country.

While there are individuals who oppose the proposed action, the action would be likely to have a positive impact on larger and more diverse groups that make up the majority of people in Hawaii. The APHIS-WS proposal does not attempt to force anyone to control frogs on their property if they want frogs. Control or eradication efforts would done only by request or landowner's permission.

The APHIS-WS proposal to control or eradicate Caribbean frogs was developed to respond to a need to take action to alleviate resident's and industry complaints about the frog and its potential impact on the ecosystem and agricultural economy and has a broad base of support by industry groups, residents, and local and state government agencies. The APHIS-WS proposal incorporated an earlier frog control plan that was developed by HDOA and hotel industry representatives and the [redacted].

One commenter expressed concerns that the proposed action may not be humane to individual frogs. Frogs have been reported to adjust to environmental moisture constraints through two mechanisms; water retention in the bladder, and osmotic adjustment through accumulation of urea or uric acid in both the blood and bladder contents (Pough et al., 1983; van Berkum et al., 1982). The mode of citric acid toxicity in frogs is likely to be via an osmotic stress mechanism where water moves out of a frog's body in response to a pressure gradient created by citric acid. In a consultation with the attending veterinarian on April 3, 2003, APHIS-WS determined that the use of citric acid as a control method would not cause more than momentary or slight pain distress (Pitt and Sin 2004). If this action is delayed, the longer the delay, the more individual frogs would be affected by control methods.

Although some individuals are opposed to frog removal efforts in Hawaii, this proposal is likely to provide overall benefit to the social and economic environments in Hawaii by removing a pest which has created excessive noise nuisance and has the potential to seriously threaten the economies of Hawaii's floriculture, horticulture, real estate, and tourism industries. People and businesses which are experiencing problems with frogs now will benefit by this proposal, while others are likely to benefit in the future if there are future infestations. Without action, the damages and threats to Hawaii's socioeconomic environment are expected to increase to levels that may prohibit an effective resolution.

4.2 Alternative 2 – No Action

4.2.1. Effectiveness

Under the "no action alternative", APHIS-WS would not take any *additional* action to eradicate the Caribbean tree frogs. It is generally recognized that without any Federal action to control or eradicate the Caribbean tree frog populations, they will spread and grow throughout the State of Hawaii.

This alternative has not been effective do date at stopping the rapid spread and expansion of Caribbean tree frogs.

4.2.2. Impacts on Non-target Animals

APHIS-WS would have no direct non-target impacts since it would not take additional action under this alternative, however, no action may result in the spread of the frogs which could lead to the destabilization of the native Hawaiian forest ecosystem, and possible loss of native species.

4.2.3. Impacts on Vegetation

APHIS-WS would not affect vegetation under this alternative, however, the spread of the invasive Caribbean tree frogs threatens to destabilize the native Hawaiian forest ecosystems.

4.2.4. Impacts on Human Health and Safety

Without the Federal program there would be no potential for APHIS-WS to negatively affect public health and safety. APHIS-WS would provide no additional benefit to public health.

High densities of the coqui frog in residential areas have become a noise nuisance due to the male's loud calls which can reach from 70 decibels (Benevides 2004) to 95 decibels for a single calling frog at 50 cm (Stewart and Bishop 1994). Complaints have been reported from residents and tourists who are disturbed by calling frogs (Kraus et al. 1999). Increases in the number and size of populations from a less effective program would be likely to increase noise complaints accordingly.

4.2.5. Impacts on Ecology and Environment

Without a Federal control program, APHIS-WS would have no additional effect on protecting the ecology of Hawaii from Caribbean tree frogs. The impact of high densities of the invasive tree frogs on the native ecosystem is expected to be significant. There is great concern that Caribbean tree frogs pose a threat to the stability of Hawaii's native forest ecosystems. The majority of native birds, some of which are endangered, are partially or wholly insectivorous. The Caribbean tree frogs could indirectly affect some populations of these birds if the frogs spread to native forest bird ranges.

An analysis of the stomach contents of the Caribbean tree frogs collected on the island of Hawaii indicates that they consume native insects (E. Campbell pers. comm.). The tree frogs could exert predation pressure on a wide variety of native arthropods, many of which may already be stressed due to the establishment of other non-native predators and parasitoids (Kraus et al. 1999). The food web balance of Hawaiian forests may be disrupted by dense populations of coqui frogs with unknown consequences. Additionally, the frogs may support future invasions of higher level vertebrate predators such as brown treesnakes (Mautz 2002).

4.2.6. Social - Economic Impacts

Invasive species are called the "single greatest threat to Hawaii's economy," (Gomes 1999). "In 1994, the federal Office of Technology Assessment declared that Hawaii has the nation's worst pest problem. Local government officials estimated in 1996 that alien pests, defined as species of harmful non-native plants, animals and microorganisms, had caused $450 million in damage annually in the state (PBN 1999). Of that, agriculture has sustained more than $300 million in yearly financial losses. That is nearly one-third of the roughly $1 billion in annual revenues for the industry, the state's largest revenue source" (Pacific Business News 1999).

Taking the No Action alternative would not assist Hawaii's horticultural exporters since frogs would be more likely to get into export materials as is depicted in the following examples:

Two calling coqui males were found in separate locations in Guam in areas associated with nursery plants (a plant nursery and a recently landscaped hotel). In each case, the frog was identified and captured. A greenhouse frog population on Guam has recently become established and is centralized around the same nursery where one of the single coquis was captured. Although no frogs have yet been identified in ornamental plant shipments from Hawaii, they are clearly the logical source of the two arrivals (D. Vice, pers. comm.).

In another recent example, a single container was held at Guam's Plant Inspection Station after three single calls were detected. The calls could not be confirmed as from inside the container or outside. (This inspection area has been used for some time as the point of release for ornamental shipments, so it is conceivable a frog had arrived on a previous container). The majority of the shipment was effectively destroyed by methyl bromide fumigation for a number of quarantine pests detected (other than frogs).

No action would allow continued spread of coqui and greenhouse frogs which are affecting businesses and land values and likely to have increased economic consequences for individuals and communities. Coqui are considered undesirable by most people.

APHIS-WS would have no impact on social values or economic resources under this alternative.

4.3 Alternative 3 – Non Chemical Only

4.3.1 Effectiveness

Non-chemical methods such as capturing by hand or with traps may be effective if the population of frogs is limited in size. Any non-chemical control method, including vegetation removal and mulching or burning is unlikely to adequately reduce tree frog population for any long term control or eradication. Non-chemical methods are expected to only reduce the number

of frogs for a time. Many populations would recover without the chemical components. The overall effect in a non-chemical only program may be temporary and is likely to be less effective than the proposed action.

4.3.2 Impacts on Non-target Animals

Non-target impacts would be dependent on the extent of habitat alterations implemented to control the frogs by removing habitat. This is not a parameter that is easy to quantify or describe since no studies have looked at the effects of this alternative. It is expected that some non-target impacts would occur through removal of vegetation to control frog populations. This alternative is expected to have a greater impact on non-target species than the other two alternatives because it would have more effects on habitat. This alternative may have restrictions for applicability in the habitat of the Hawaiian hoary bat.

4.3.3 Impacts on Vegetation

More vegetation would probably need to be removed under this alternative as compared with the proposed action since reliance is placed only on non-chemical control. Clear cutting infested areas, then burning the debris in place and bulldozing can alter the soil structure and would be likely to have a greater negative effect on vegetation than using citric acid sprays with limited vegetation removal. This alternative is likely to have the greatest impact on vegetation since it relies on habitat modification as a major component, but effects on vegetation are likely to be less than the total area affected by frogs, currently estimated to be 3,000 acres due to limitations for clearing. This alternative may have limitations in residential areas, as well as limitations in the habitat of the Hawaiian hoary bat.

4.3.4 Impacts on Human Health and Safety

It is unlikely that human health and safety would be a great concern with a non-chemical control operation. The smoke from burning debris could have some affect on people with asthma and other respiratory ailments but it would be temporary. Safety may be a concern and a controlled burn would have to be carefully monitored. Burning may not be desirable near residences, resorts and business establishments.

4.3.5 Impacts on Ecology and Environment

Current estimates indicate that the distribution of frogs is limited to about 3,000 acres or .042 percent of the total land area of Hawaii. Even if clear cutting, burning and bulldozing were possible on the entire 3,000 acres, it is doubtful that such habitat removal would affect the ground water and aquatic environments. Soil retention barriers or other erosion and sediment control devices or plans would be implemented to minimize effects on soils and

water quality. No bulldozing would be planned along streams and in wetlands.

Soils and ground substrates such as aa rocks (porous clinker lava) would need to be disturbed to achieve complete habitat removal and eradication of tree frog populations.

4.3.6 Social - Economic Impacts

Non chemical controls would probably cost the landowner more and be less effective in controlling the frogs than the proposed alternative. Vegetation removal of a large area would probably be cost prohibitive and likely not achieve the desired results since many frogs would escape being killed. The economic impacts of successful control would be the same as the proposed alternative, but it is unlikely that non chemical control would succeed. It is the absence of a chemical control remedy that allowed the frog populations to grow.

This alternative would be likely to affect those individuals who are opposed to removing the Caribbean tree frog similar to the proposed action since frogs would still be removed. Most people directly affected by the frog would likely prefer a more effective alternative.

This proposal may provide less economic benefit to Hawaii's economy since the benefit would correlate with the effectiveness of the program.

Most sites occupied by Caribbean tree frogs are located on vacant residential lots, residences, hotels and around floriculture and horticulture establishments where historic resources would not be affected. If bulldozing were determined to be necessary, APHIS-WS would consult with the State Historic Preservation Office if frogs are found in previously undisturbed areas or areas known to contain historic resources to determine if the proposal could affect historic resources and to adopt appropriate protective measures.

4.4 Cumulative Impacts

Current estimates are that frogs have been reported on 327 sites occupying approximately 3,000 acres on the islands of Hawaii, Maui, Oahu and Kauai, which is .042 percent of the total land area of the state. The populations are still discrete. A few sites on the island of Hawaii have population densities that are high, but they occupy only a few acres. A large majority of the reported sites have a very small number of frogs. Most of these sites are located on vacant residential lots, residences, hotels and around floriculture and horticulture establishments. A frog control and eradication project would be limited to a relatively small total area. Individual residents and property owners may apply citric acid to control tree frog populations directly to their property.

The primary control method of the proposed action, citric acid in solution, had no effect on the abundance and species diversity of non-target invertebrates at the

Lava Tree State Park project site in Pahoa, Hawaii (Chun et al. 2003a) and the Lawai, Kauai project site (R. Sugihara pers. comm.). Vegetation clearing in the scale of the Lava Tree State Park project was found not to be necessary to control coqui frogs with citric acid, based on successful results from Lawai, Kauai project.

The pH level of water in Aepo Reservoir within the Lawai project site did not become more acidic after the application of 1,000 gals of a 16 percent citric acid solution. (R. Sugihara pers. comm.), thus no effects on water quality are expected from the use of citric acid.

Finding no negative effects on non-target species, vegetation and water at project test sites indicates that there would not be any measurable cumulative impacts if control and eradication efforts using citric acid were applied to the current distribution of coqui and greenhouse frogs by APHIS-WS and property owners. These determinations are based on expected citric acid application procedures which can require repeat application of citric acid including one full treatment with follow up spot treatments until frogs are controlled.

The public and other entities can be expected to do their own frog control since the most effective method available thus far, citric acid solution, is also available to the general public. Presumably, the less available the APHIS-WS program is to assist with a professional control program, the more citric acid, and other methods would be applied by the public. APHIS-WS is likely to be more efficient and effective under the proposed action with the use of citric acid as a control tool, since it is specifically trained and experienced in the activity, and since it has a close working relationship with its research center, NWRC, who was integral in developing and testing the method. In addition, APHIS-WS, as a Federal agency is accountable to the public for its actions, is required to keep detailed records, and consult with all cooperating agencies, including the USFWS on potential effects on T&E species.

It is likely that the proposed action's cumulative effects would be more desirable under the proposed action. Because it is likely to be most effective, the WS program would be more successful in the eradication attempts and at controlling those populations where eradication was not feasible. Thus it would have the greatest benefit to Hawaii's horticulture, floriculture, real estate and tourism industries, and would be most likely to protect Hawaii's delicate ecosystem by removing or minimizing the threat of these invasive pests. Finally, the proposed action would be most likely to assist the general public which experiences distress due to the noise impact of the frog. While none of the alternatives considered would be likely to have any sustained negative impact on the environment, the proposed action would be likely to provide the most benefit by effectively controlling, and eradicating where possible, populations of Caribbean tree frogs.

4.5 Monitoring

The USDA APHIS-WS program actively monitors the effects of its programs to determine if the effects fall within projected results. When program environmental effects are substantially different than projected, or if new environmental issues arise, new information becomes available, the regulatory framework changes, or a

new reasonable alternative that should be considered is identified, the USDA APHIS-WS may determine that additional NEPA compliance measures are necessary.

Any Caribbean frog control program resulting from this EA would be monitored in three different ways:

1. Management Information System (MIS). A primary record keeping system established by APHIS-WS is the MIS. The MIS will record the target animals taken, any non-target animals affected, and methods used. Review of the MIS facilitates a determination of whether or not program impacts will fall within levels determined through this EA.

2. NEPA Monitoring and Review. It is APHIS-WS policy to review all NEPA documents to determine if they are still valid or if substantial changes warrant additional NEPA compliance. APHIS-WS routinely reports on its findings to the Federal Decision maker to ensure that NEPA compliance is up-to-date. APHIS-WS NEPA documents and/or decisions are normally reissued to the public every 5 years at a minimum, and sooner if new information substantially changes the proposed action, issues, alternatives or environmental impact findings.

3. Adaptive Managemennt: APHIS-WS, in collaboration with NWRC and its cooperating agencies will continue to collect information on non-target plant and animal impacts, water quality, program efficacy, and Caribbean frog locations and characteristics. New information would be considered against the selected alternative to determine if program changes are warranted. Substantial program changes may warrant additional NEPA compliance and public involvement

Conclusions

The action proposed by this environmental assessment is the implementation of an Integrated Pest Management approach with a citric acid chemical control component to control and eradicate the invasive Caribbean tree frog populations in the State of Hawaii. No significant negative impacts would be expected from the implementation of this proposal. The proposed action is intended to provide benefit to Hawaii's economy and ecology by reducing economic impacts to Hawaii's horticulture and floriculture industry, reducing noise nuisance and safeguarding Hawaii's native ecosystems and endangered species from yet another threat.

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APPENDIX A

APPENDIX B

APPENDIX C

APPENDIX D